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EPITHELIOCYSTIS INFECTION OF FISHES

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Introduction

Epitheliocystis is a chronic disease, sometimes benign but sometimes lethal, characterized by hypertrophied epithelial cells in the gills and skin of certain fishes. Light infections easily pass unnoticed but heavy infections may result in severe respiratory distress. The name was originated by Hoffman et al. (1969), who described the condition in epithelial cells of the bluegill (*Lepomis macrochirus*). Mucophilosis of common carp (*Cyprinus carpio*), first considered by Plehn (1920) to be caused by an intracellular alga, was later shown to be a form of epitheliocystis (Molnár and Boros 1981).

Clinical Signs and Pathology

When infections are light, clinical signs are lacking, but gross examination may show minute, white to gray, spherical cells scattered over the gills or (in bluegills) over the fins and body. These cells are sometimes confused with adults of the ciliate *Ichthyophthirius*. When infections are heavy, fish show signs of respiratory distress similar to those seen in bacterial gill disease, infestations with gill parasites, or anemia. Gross examination of such fish shows numerous round bodies that often result from coalescence of two or more smaller cells. Mortality due to epitheliocystis in cultured fishes has been identified in the sea bream (*Sparus aurata*) and grey mullet (*Liza ramada*) in Israel, as well as in common carp in Europe and rainbow trout (*Salmo gairdneri*) in the United States. The synchronous discharge of cells from heavily infected striped bass (*Morone saxatilis*) apparently predisposed the fish to bacterial gill disease that resulted in high mortality. The characteristic histological lesions of epitheliocystis are hypertrophied epithelial cells 20 to 400 μm in diameter, on or between the gill lamellae. The hypertrophic nucleus and cytoplasm are peripheral to a granular basophilic inclusion (Fig. 1). A hyaline, eosinophilic capsule surrounds the cell. The hyperplastic response of the host, which may cause fusion of adjacent lamellae, is considered to be the cause of respiratory problems in severe infections. The infected cells in epitheliocystis are similar to cells infected with lymphocystis virus, but are smaller at maturity and differ in the position of the nucleus and the inclusion body (Fig. 1.)

Etiology and Diagnosis

The characteristics of Chlamydia and Rickettsia—organisms classified between viruses and bacteria—encompass those of the epitheliocystis agent; however, the taxonomic position of the epitheliocystis organism is unsettled. Paperna et al. (1981) believed that it belonged to a distinct group in the Chlamydiales, but T. Bradley (University of Rhode Island, Fisheries Aquaculture and Pathology, personal communication) reported that currently available polyclonal chlamydial antibody does not react with the epitheliocystis agent. As viewed with the electron microscope, the basophilic inclusion consists of bodies whose size (0.2 to 1.0 μm) and shape (round, elongate, or clubbed) vary with the host and with the stage of development, where a multiform life cycle has been demonstrated. Basically, however, the inclusions consist of an electron-dense nucleoid surrounded by electron-lucent material, a grainy electron-dense zone, and a limiting membrane. Chlamydia are gram-negative, are colored blue with Giemsa stain and red with Macchiavello stain, and are positive for DNA.

A presumptive diagnosis can be made by the histological demonstration of the typical hypertrophied cell in the gill epithelium containing a grainy inclusion with the staining characteristics described. Confirmation requires the demonstration of chlamydia by electron microscopy. Chlamydia of homeotherms can be grown in cell cultures, but the epitheliocystis agents have yet to be grown.

Host and Geographic Range

Epitheliocystis has a broad range of hosts in the Northern Hemisphere, infecting members of at least 15 families of fishes: Salmonidae, Ictaluridae, Percichthyidae, Centrarchidae, Mullidae, Mugilidae, Cottidae, Tetradontidae, Cyprinidae, Gadidae, Serranidae, Sparidae, Cichlidae, Scorpaenidae, and Pleuronectidae.

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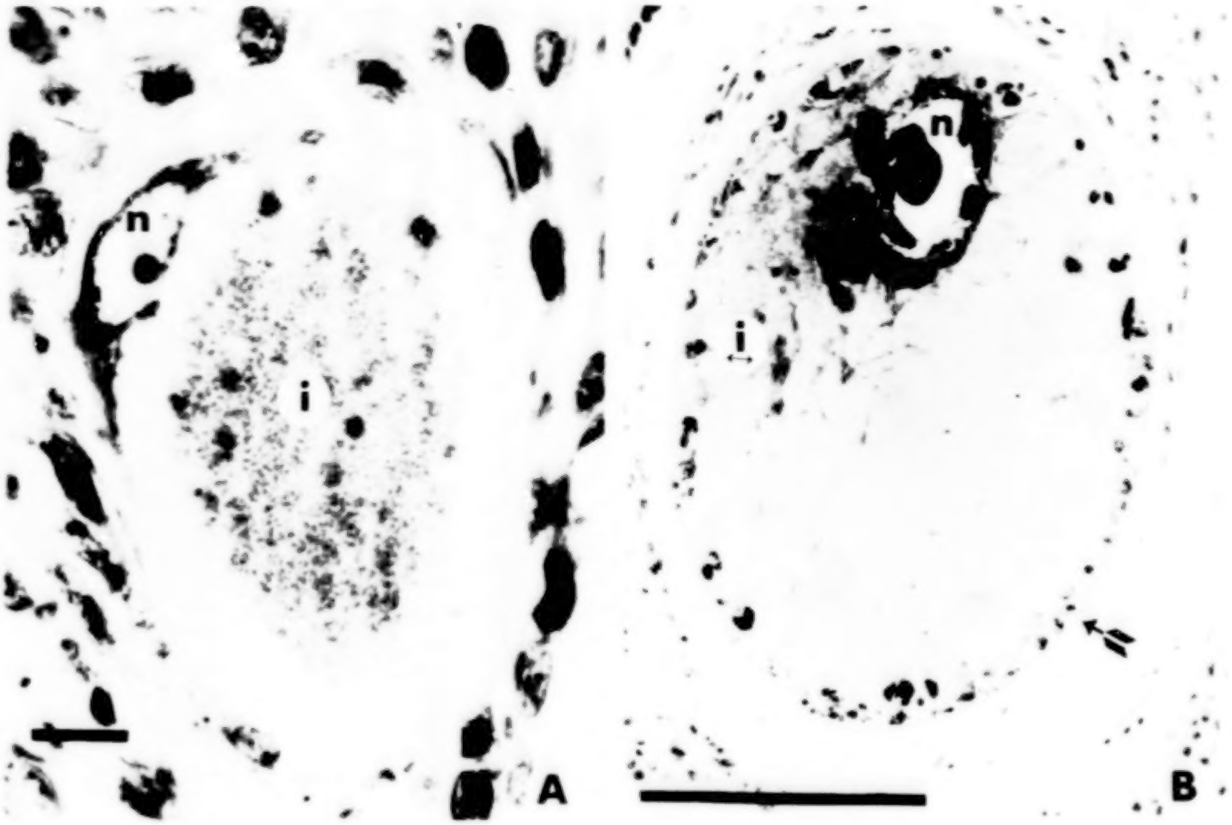

Fig. 1. Individual cells infected with the epitheliocystis organism (*A*) or lymphocystis virus (*B*). In both, the cell, nucleus (*n*), and nucleolus are enlarged and a hyaline capsule (larger arrow in *B*) surrounds the cell. Cells infected with epitheliocystis are characterized by the large grainy inclusion (*i*) that occupies most of the cell volume, and peripheral displacement of the cytoplasm and nucleus. In contrast, lymphocystis-infected cells have irregular inclusions (*i*) scattered through the cytoplasm and no dislocation of the nucleus. (Bar equals 10 μm in *A* and 100 μm in *B*).

The infection occurs in both wild and cultured fishes in marine and freshwater environments in the Northern Hemisphere, and has also been reported from South Africa.

Reservoir and Incubation

Limited studies of transmission, and observations of hatchery epizootics, indicate that horizonal transmission occurs readily. Circumstantial evidence also indicates that transmission on inaminate objects (e.g., equipment or clothing) may occur under cultural conditions. The possible role of vectors or transport hosts is unknown. An incubation time of 3 to 6 weeks has been suggested. Extracellular survival of the epitheliocystis organism has not been studied.

Control

Avoidance is the only control known. Studies designed to thoroughly demonstrate the efficacy of chemotherapy in fish have not been conducted. Chlamydia in higher animals are susceptible to broad-spectrum antibiotics such as tetracycline and penicillin.

Annotated Bibliography

Herman, R. L. 1985. Striped bass fingerling mortality involves multiple factors. Fish Health News 14(3): iii-v.

Epitheliocystis cells seemingly ruptured synchronously within a 48-h period, causing sufficient gill tissue damage to initiate severe bacterial gill disease.

Hoffman, G. L., C. E. Dunbar, K. Wolf, and L. O. Zwillenberg. 1969. Epitheliocystis, a new infectious disease of the bluegill (*Lepomis machrochirus*). Antonie Leeuwenhoek J. Microbiol. Serol. 35:146-158.

The first use of the term epitheliocystis, the first indication that the organism might be of a chlamydial type, the first report of its occurrence in bluegills, and the only report of lesions in locations other than on the gills.

Miyazaki, T., Y. Fujimake, and K. Hatai. 1986. A light and electron microscopic study on epitheliocystis disease in cultured fishes. Bull. Jpn. Soc. Sci. Fish. 52:199-202.

The infection is described from two new species and from two new geographical areas—China and Japan. Ultrastructure of the organism in the red sea bream (*Pagrus major*) is described.

Molnar, K., and G. Boros. 1981. A light and electron microscopic study of the agent of carp mucophilosis. J. Fish Dis. 4:325-334.

The agent of carp mucophilosis is shown to be an organism of a rickettsial or chlamydial type. The agent is very similar to that found in epitheliocystis in other fishes.

Morrison, C., and G. Shum. 1983. Epitheliocystis in American plaice, *Hippoglossoides platessoides* (Fabricius). J. Fish Dis. 6:303-308.

The agent is described as similar to the round-cell form reported from Israel. Affinity to the Rickettsiales is suggested.

Paperna, I. 1977. Epitheliocystis infection in wild and cultured sea bream (*Sparus aurata*, Sparidae) and grey mullets (*Liza ramada*, Mugilidae). Aquaculture 10:169-176.

Infection of sea bream resulted in severe proliferation of gill epithelial cells and subsequent mortality. The morphology of the agents is different in the two species, and different from the morphology of the agent in striped bass. It is suggested that these organisms have high host specificity.

Paperna, I., and A. P. Alves de Matos. 1984. The developmental cycle of epitheliocystis in carp, *Cyprinus carpio* L. J. Fish Dis. 7:137-147.

A pleomorphic developmental cycle is described in carp. The infection occurs in chloride and surface epithelial cells, as well as in mucous cells. The forms are compared with those seen in other fishes.

Paperna, I., and I. Sabnai. 1980. Epitheliocystis disease in fishes. Pages 228-234 *in* W. Ahne, ed. Fish diseases. Proceedings in life sciences. Springer-Verlag, Heidelberg, West Germany.

A concise review of knowledge of the disease and its agents through 1979.

Paperna, I., I. Sabnai, and M. Castel. 1978. Ultrastructural study of epitheliocystis organisms from gill epithelium of the fish *Sparus aurata* (L.) and *Liza ramanda* (Risso) and their relation to the host cell. J. Fish Dis. 1:181-189.

Detailed descriptions show similarities and differences between the two organisms and comparable agents from other fishes. Compared with chlamydia from homeotherms, the agents in fish show some similarities and some differences.

Paperna, I., I. Sabnai, and A. Zachary. 1981. Ultrastructurai studies in piscine epitheliocystis: evidence for a pleomorphic developmental cycle. J. Fish Dis. 4:459-472.

A pleomorphic developmental cycle for epitheliocystis is described from hosts representing four families. The cycle consists of primary long cells, intermediate long cells, and small cells. Round cells are found in chloride cells as an apparent additional stage. The relationship of epitheliocystis to chlamydia from other vertebrates and from invertebrates is discussed.

Plehn, M. 1920. Neue Parasiten in Haut und Kiemen von Fischen. Centralblatt fur Bakteriologie, Parasitenkunde, Infektionskrankeiten und Hygiene I. Abteilung Originale 85:275-281.

The original description of *Mucophilus* infection of common carp, which is now considered to be a form of epitheliocystis.

Rourke, A. W., R. W. Davis, and T. M. Bradley. 1984. A light and electron microscope study of epitheliocystis in juvenile steelhead trout, *Salmo gairdneri* Richardson. J. Fish Dis. 7:301-309.

The first description of epitheliocystis from a salmonid. A form that has a tail-like appendage is distinct from other epitheliocystis forms. The basic morphology is similar to that of forms found in other hosts and seems to conform to the characteristics of chlamydia.

Wolf, K. 1981. Chlamydia and rickettsia of fish. Fish Health News 10(3):i-v.

A brief, concise history of epitheliocystis. Chlamydia and rickettsia are compared and an argument is made for including epitheliocystis agents in the chlamydial group.

Wolke, R. E., D. S. Wyand, and L. H. Khairallah. 1970. A light and electron microscopic study of epitheliocystis disease in the gills of Connecticut striped bass (*Morone saxatilis*) and white perch (*Morone americanus*). J. Comp. Pathol. 80:559-563.

The first description of epitheliocystis from *Morone*. The morphology and staining characteristics indicate an agent of the Bedsonia (=Chlamydia) type. It is suggested that the large cysts may be formed by coalescence of two or more cells.

Zachary, A., and I. Paperna. 1977. Epitheliocystis disease in the striped bass *Morone saxatilis* from the Chesapeake Bay. Can. J. Microbiol. 23:1404-1414.

The first study of epitheliocystis for which samples were taken specifically for electron microscopy. Similarities to chlamydial and rickettsial agents were found. Primarily because of the apparent lack of developmental forms, the authors considered the organisms to belong to the rickettsia.

Zimmer, M. A., M. S. Ewing, and K. M. Kocan. 1984. Epitheliocystis disease in channel catfish, *Ictalurus punctatus* (Rafinesque). J. Fish Dis. 7:407-410.

A short case history reporting a new host species. The morphology of the organism is similar to that of the round cells described from chloride cells of other hosts.

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